

# WORKSHOP

SEG/SPE/ARMA Workshop

## Injection Induced Seismicity

The Banff Center

Banff, Alberta, Canada

15–18 September 2014



Monday, 15 September 2014			
4:00 PM	7:30 PM	Registration/Check-In	Max Bell Building
5:30: PM	7:30 PM	Welcome Reception	Max Bell Building
Dinner on Own			

*Preliminary Program Subject to Change*

Preliminary Program				
SEG/SPE/ARMA Injection Induced Seismicity Workshop				
Tuesday, September 16, 2014				
7:30 AM	5:00 PM	Registration/Check-In    Max Bell Foyer		
8:00 AM	8:15 AM	Welcome and Safety Information		
Session 1: Case Histories: Wastewater Disposal and Hydraulic Fracturing      Session Chairs: Mike Fehler and Julie Shemeta				
8:15 AM	8:30 AM	Understanding the Anomalous Seismicity of the Central United States "Brick-by-Brick"	Bill Ellsworth	US Geological Survey
8:30 AM	8:45 AM	Understanding North Texas Seismicity: A Joint Analysis of Seismic Data and 3D Pore Pressure Modeling	Heather DeShon	Southern Methodist University
8:45 AM	9:00 AM	Establishing Regional Seismic Patterns Before and After Shale Gas Development in Northeast BC	Honn Kao	Geological Survey of Canada
9:00 AM	9:15 AM	Source and Attenuation Parameters for Seismicity in the Crooked Lake Region of Alberta	Gail Atkinson	Western University
9:15 AM	9:30 AM	Waste Water Injection Induced Seismicity in Naturally-Active Seismogenic Regions in Central California	Thomas Goebel	Seismological Lab CAL Inst. of Technology
9:30 AM	10:00 AM	Presenter Panel Question and Answer		
10:00 AM	10:30 AM	Coffee Break    Max Bel Foyer		
Session 2: Case Histories: Europe and Carbon Sequestration      Session Chairs: Julie Shemeta and Mike Fehler				
10:30 AM	10:45 AM	The ML3.5 Induced Earthquake Sequence at Sankt Gallen, Switzerland	Toni Kraft	Swiss Seismological Services

<b>10:45 AM</b>	<b>11:00 AM</b>	Induced Seismicity monitoring at the Decatur, IL, CO_ Sequestration Demonstration Site	J. Ole Kaven	USGS Earthquake Science Center
<b>11:00 AM</b>	<b>11:15 AM</b>	Overview of Induced Microseismic Activity in the Illinois Basin - Decatur Project	Marcia Coueslan	SLB Carbon Services
<b>11:15 AM</b>	<b>11:30 AM</b>	Study for understanding of the physics behind induced seismic events with large magnitude at EGS project in Basel, Switzerland	Yusuke Mukuhira	Tohoku University
<b>11:30 AM</b>	<b>12:00 PM</b>	<b>Presenter Panel Question and Answer</b>		
<b>12:00 PM</b>	<b>1:30 PM</b>	<b>Lunch    Vistas Dining Room</b>		
<b>Session 3: Case Study Posters</b>			<b>Session Chair: Hal Macartney</b>	
<b>1:30 PM</b>	<b>3:00 PM</b>	Blackpool (UK), 2011, and Objective Tool to Distinguish Between Induced and Natural Seismicity	Miroslav Hallo	SEISMIK S.R.O.
		The Curious Case of Oklahoma Seismicity	Rall Walsh III	Stanford University
		Understanding North Texas Seismicity: Detailed Seismic Studies of the Azle Earthquake Sequence	Chris Hayward	Southern Methodist University
		Detection of Ohio Hydraulic Fracture Induced Seismicity Using Cross-Correlation Detectors Using IRIS Transportable Array Broadband Data	Paul Friberg	ISTI
		Source Parameters of the Crooked Lake Induced Seismicity Sequence	Alireza Mahani	University of Calgary
		Montney Trend and Water Disposal Well Induced Seismicity in NEBC	Dan Walker	British Columbia Oil
		Seismic Moment Partitioning During Injection: Insights from Case Studies and Numerical Simulations	Loes Buijze	TNO Dutch Geophysical Survey, Utrecht U.
<b>3:00 PM</b>	<b>3:15 PM</b>	<b>Coffee Break    Max Bell Foyer</b>		
<b>3:15 PM</b>	<b>3:30 PM</b>	<b>Poster Presenter Panel Question and Answer</b>		
<b>Technical Sessions Day One Wrap Up</b>			<b>Session Chair: Hal Macartney</b>	
<b>3:30 PM</b>	<b>3:45 PM</b>	Liability Arising from Induced Seismicity in Canada	Allan Ingelson	University of Calgary
<b>3:45 PM</b>	<b>4:00 PM</b>	Induced Seismicity: USGS Role and Activities	Bill Leith	US Geological Survey
<b>4:00 PM</b>	<b>5:00 PM</b>	<b>Discussion Time &amp; Question of the Day</b>		

*Dinner on Own*

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**Wednesday, September 17, 2014**

7:45 AM	5:00 PM	SEG Desk    Max Bell Foyer					
Session 4:		Geomechanics and Fluid Flow Modeling				Session Chairs: Norm Warpinski and Pat McLellan	
8:15 AM	8:30 AM	Application of large-Scale Earthquake Simulations to Seismicity Induced by Fluid Injection				James Dieterich	University of California Riverside
8:30 AM	8:45 AM	Preliminary Simulations of the Interaction Between of Pore Fluids and Seismicity with RSQSim				Kayla Kroll	University of California, Riverside
8:45 AM	9:00 AM	The Search for a Unifying Model of Fluid Injection Related Induced Seismicity				Mark Leidg	Weston Geophysical
9:00 AM	9:15 AM	Downward Migration of Injection Induced Seismicity Driven by Buoyancy Force				Sharad Kelkar	Los Alamos National Laboratory
9:15 AM	9:30 AM	Considerations in Disposal Well Sitting and Operations: Relative Hazard and Identification of Injection-Induced Seismicity Using Regional or				Austin Holland	Oklahoma Geological Survey
9:30 AM	10:00 AM	Presenter Panel Question & Answer					
10:00 AM	10:30 AM	Coffee Break    Max Bell Foyer					
Session 5:		Geomechanics and Fluid Flow Modelling				Session Chairs: Pat McLellan and Norm Warpinski	
10:30 AM	10:45 AM	Induced Seismicity Over the Groningen Gas Field: Integrating Geological, Dynamic Flow and Geomechanical Models				Karin van Thienen-Visser	TNO Geo. Survey of the Netherlands
10:45 AM	11:00 AM	Geomechanical Challenges Associated with Modeling Injection-Induced Seismicity				Will Pettitt	Itasca International
11:00 AM	11:15 AM	Fluid Pressure Wave Triggering of Large Earthquakes				Francesco Mulargia	Universitid di Bologna
11:15 AM	11:30 AM	A Simple Model of Injection Induced Seismicity Including Poro-Elastic and Time Dependent Earthquake Nucleation				Paul Segall	Stanford University
11:30 AM	12:00 PM	Presenter Panel Question & Answer					
12:00 PM	1:30 PM	Lunch    Vistas Dining Room					
Session 6:		Modeling Posters				Session Chair: Rod Gertson	
1:30 PM	3:00 PM	The Impacts of Mechanical Stress Transfers Caused by Hydromechanical and Thermal Processes on Fault Stability During Hydraulic Stimulation in a Deep Geothermal Reservoir				Pierre Jeanne	Lawrence Berkeley National Lab
		Seismic Activity Associated With the Castor Gas Injection Operation, September 2013, Offshore Castell�n, Spain				Rodrigo del Potro	University of Bristol
		Optimizing Multi-Station Template Matching to Identify and Characterize Induced Seismicity				Robert Skoumal	Miami University at Ohio

<b>1:30 PM</b>	<b>3:00 PM</b>	Designing Networks for Induced Seismicity: A Method to Ensure that Seismic Performance Expectations Are Met at the Time of Network Installation	Wesley Greig	Nanometrics Inc.
		Constrained and Unconstrained Waveform Based Full Moment Tensor Inversion Under Different Station Configurations	Chen Gu	MIT
		A Case Study: Determination of High-Quality Focal Mechanism Solutions Using Microearthquake P-Wave Onsets	Ivan Rabak	Global Geophysical Services, Inc.
		Bayesian Inversion of Diffusivity from Observed Microseismicity	Oleg Poliannikov	MIT
<b>3:00 PM</b>	<b>3:15 PM</b>	<b>Coffee Break    Max Bell Foyer</b>		
<b>3:15 PM</b>	<b>3:30 PM</b>	<b>Poster Presenter Panel Question and Answer</b>		
<b>Day Two Wrapup</b>			<b>Session Chair: Rod Gertson</b>	
<b>3:30 PM</b>	<b>4:00 PM</b>	Can We Identify (and Avoid) Siting Wastewater Injection Wells Near Potentially Active Faults? A Practical Case Study in Oklahoma	Mark Zoback	Stanford University
<b>4:00 PM</b>	<b>5:00 PM</b>	<b>Discussion Time &amp; Question of the Day</b>		
<b>6:00 PM</b>	<b>8:00 PM</b>	<b>Group Dinner    Location TBD</b>		

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<b>Thursday, September 18, 2014</b>				
<b>7:45 AM</b>	<b>5:00 PM</b>	<b>SEG Desk    Max Bell Foyer</b>		
<b>Session 7: Seismic Hazards and Risk Assessment</b>		<b>Session Chairs: Dave Eaton and Hal Macartney</b>		
<b>8:15 AM</b>	<b>8:30 AM</b>	Technical Considerations Associated With Risk Management of Potential Induced Seismicity in Injection Operations	Kris Nygaard	ExxonMobil
<b>8:30 AM</b>	<b>8:45 AM</b>	Increased Earthquake Rates in the Central and Eastern US Portend Higher Earthquake Hazards	Andrea Llenos	US Geological Survey
<b>8:45 AM</b>	<b>9:00 AM</b>	Predicting Ground Motions from Injection-Induced Earthquakes	Ivan Wong	URS Corporation
<b>9:00 AM</b>	<b>9:15 AM</b>	Quantifying the Seismic Hazard from Natural and Induced Earthquakes	Justin Rubinstein	US Geological Survey
<b>9:15 AM</b>	<b>9:30 AM</b>	Seismic Risk; Regulatory Issues	Annemarie Muntendam-Bos	State Supervision of Mines
<b>9:30 AM</b>	<b>10:00 AM</b>	<b>Presenter Panel Question and Answer</b>		
<b>10:00 AM</b>	<b>10:30 AM</b>	<b>Coffee Break    Max Bell Foyer</b>		
<b>Session 8: Induced Seismicity Operational Protocols and Risk Mitigation</b>		<b>Session Chairs: Hal Macartney and Dave Eaton</b>		
<b>10:30 AM</b>	<b>10:45 AM</b>	Understanding Stoplight Systems as a Risk Mitigation Tool	Randy Pharis	XTO Energy
<b>10:45 AM</b>	<b>11:00 AM</b>	Assessing IS Risk Potential in Field Planning & Development	Steve Willson	Apache Corp.

<b>11:00 AM</b>	<b>11:15 AM</b>	Managing Induced Seismic Risk: An Example from Lancashire, Northwest England	Andrew Quarles	Cuadrilla Resources
<b>11:15 AM</b>	<b>11:30 AM</b>	An Analytical Approach to Hydraulic Fracturing and Induced Seismicity	John Duhault	Lightstream Resources
<b>11:30 AM</b>	<b>12:00 PM</b>	<b>Presenter Panel Question and Answer</b>		
<b>12:00 PM</b>	<b>1:30 PM</b>	<b>Lunch    Vistas Dining Room</b>		
<b>Session 9: Seismic Hazard Posters</b>			<b>Session Chair: Shawn Maxwell</b>	
<b>1:30 PM</b>	<b>3:00 PM</b>	Injection Wells: Minimizing the Risk of Induced Seismicity	Jeff Bull	AXPC SME Group
		The Role of Probabilistic Approaches in EGS Hazard Assessment	Andrew Jupe	Altcom Limited
		Prediction of Magnitude of the Largest Potentially Induced Seismic Event	Miroslav Hallo	SEISMIK Ltd.
		Empirical Ground Motion Prediction Equation for Induced Seismicity Related to Hydraulic Fracture Stimulation	Sepideh Karimi	Engineering Seismology Group.
		Development of a Comprehensive Site Characterization Protocol for Reducing Risks Associated with Injection-Related Triggered Seismicity	Randi Walters	Stanford University
		Monitoring Seismicity in the Horn River Basin - A Comparison of	Jason Hendrick	Nexen Energy ULC
<b>3:00 PM</b>	<b>3:15 PM</b>	<b>Coffee Break</b> Max Bell Foyer		
<b>3:15 PM</b>	<b>3:30 PM</b>	<b>Poster Presenter Panel Question and Answer</b>		
<b>Day Three Wrapup</b>			<b>Session Chair: Shawn Maxwell</b>	
<b>3:30 PM</b>	<b>4:30 PM</b>	<b>Workshop Wrap-up and Discussion</b>		

**Adjourn**





